* NOTICES *

JPO and INPIT are not responsible for any

damages caused by the use of this translation.

1.This document has been translated by computer. So the translation

may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

....

CLAIMS

....

[Claim(s)]

[Claim 1] It is the information storage system which consists of two or

more information storage devices which receive the write request of the

data which high order equipment publishes, and control the writing to

said data storage medium. The 1st sequence grant information offer

means which generates the sequence grant information for identifying

the sequence that connected with said two or more information storage

devices, and the write-in instruction of said high order equipment was

published, The 2nd sequence grant information offer means which

generates the sequence grant information for identifying the sequence

that connected with said two or more information storage devices, and

the write-in instruction of said high order equipment was published The

information storage system characterized by for the sequence grant

information offer means of the hidden above 1st and said 2nd sequence

grant information offer means carrying out mutually-independent, and

establishing them.

[Claim 2] It is the information storage system according to claim 1 which

has a definition means to define any one of said 1st and 2nd sequence

grant information offer means as a master sequence grant information offer means, and is characterized by said information storage system acquiring the sequence of the write-in instruction from said high order equipment with the master sequence grant information offer means defined by said definition means.

[Claim 3] It has a judgment means to judge how it is. offer of the sequence grant information from the sequence grant information offer means defined as said master to said information storage device is possible -- The information storage system according to claim 2 characterized by said definition means redefining other sequence grant information offer means which are not defined as said master as a master sequence grant information offer means when the judgment result of said judgment means is what shows an offer impossibility [claim 4] The information storage system according to claim 2 or 3 with which the information storage device with which the judgment result of said judgment means detected that it could not provide carries out the description of not performing the write request from said high order equipment.

[Claim 5] The information storage system according to claim 4 which carries out the description of the information storage device with which the judgment result of said judgment means detected that it could not provide notifying the purport which is made not to perform the write request from said high order equipment to other information storage devices which constitute said information storage system.

[Claim 6] The information storage system according to claim 4 or 5 with which the sequence grant information offer means which was redefined by said definition means and became a master is characterized by publishing the notice of the purport which resumes activation of the write request from said high order equipment to said information storage

device.

[Claim 7] It is the information storage system which consists of two or more information storage devices which receive the write request of the data which high order equipment publishes, and control the writing to said data storage medium. Connect with said two or more information storage devices, and the 1st sequence grant information offer means which generates the sequence grant information for identifying the sequence that the write-in instruction of said information processor was published is included. Said 1st sequence grant information offer means has the processing section which performs an adjustment skew on the clock which the clock receive section and external clock receive section which receive the clock from the outside received. Said adjustment skew Said sequence grant information offer means, The information storage system characterized by calculating the adjustment value corresponding to distance with said two or more information storage devices.

[Claim 8] In the remote information storage system which consists of the 1st information storage system which consists of two or more information storage devices, and becomes a copied material, and the 2nd information storage system which consists of two or more information storage devices, and serves as a copy place Said information storage device receives the data write-in instruction from an information processor. A storage control means to control the writing to said data storage medium is included. The 1st sequence grant information offer means which offers the information about issue sequence grant of a write-in instruction of the data published from said information processor to each information storage device which is connected to said 1st information storage system, and constitutes said 1st information storage system, and said 2nd information storage system When

redefined as a copied material, it has the 2nd sequence grant information offer means which offers the information about issue sequence grant of a write-in instruction of the data published from said information processor to each information storage device which constitutes the 2nd information storage system. The remote information storage system characterized by coming to prepare bidirectionally the means of communications which can communicate information between said 1st information storage system and said 2nd information storage system.

[Claim 9] possible [in offer of the sequence grant information on the 1st information storage system which consists of said 1st sequence grant information offer means said copy origin] in a remote storage system according to claim 8 -- the remote storage system by which it has a judgment means judge whether how it is, and said 2nd sequence grant information offer means offers sequence grant information to said 1st information storage system when the judgment result of said judgment means is what shows an offer impossibility.

[Claim 10] It is the remote storage system characterized by having the processing section which processes the timing skew according to distance with said information storage device with which each of said 1st and 2nd sequence grant information offer means offers sequence grant information in a remote storage system according to claim 9.

[Claim 11] Connect with high order equipment and the write request of the data from said high order equipment is received. It is the information storage device which has a storage control means to control the writing of said data to a record medium. Said storage control means The 1st memory which accumulates the information which carries out ranking of the write request of the data which acquired sequence grant information from the information storage device exterior, and were published from

said high order equipment, The 2nd memory which memorizes whether acquisition of the sequence grant information from said information storage device outside was made normally is included. It has a judgment means to judge whether said 2nd memory was read and acquisition of said sequence grant information was normally made when the write request from said high order equipment was received. The information storage device characterized by being in the write-in data inflow refusal condition from said high order equipment when the judgment result of said judgment means is what shows not being acquired normally.

[Claim 12] To the information storage device which has a storage control means to be connected to high order equipment, to receive the write request of the data from said high order equipment, and to control the writing of said data to a record medium It is a sequence grant information offer means for offering the order of issue of the write-in instruction from said high order equipment equipment. Said sequence grant information offer means It has the analysis processing section which generates sequence grant information based on the clock signal which said clock receive section received. the clock receive section which receives the clock from the outside -- ** -- A sequence grant information offer means to disseminate said sequence grant information processed by said analysis processing section to said information storage device.

[Claim 13] A sequence grant information offer means according to claim 12 by which said analysis processing section is characterized by performing a timing skew based on the distance of said information storage device and said sequence grant information offer means.

[Claim 14] Connect with high order equipment and the write request of the data from said high order equipment is received. It is the information storage device which has a storage control means to control the writing

of said data to a record medium. Connect with said information storage device and a sequence grant information offer means to offer the information about issue sequence grant of a write-in instruction of the data published from said high order equipment is included. The self-propelled timer counted with the clock of a processor own [in said information storage device], The information storage device characterized by having the local memory of a processor own [said] which accumulates the timer value which said self-propelled timer counted, and amending the timer value in said local memory based on the sequence grant information acquired from said sequence grant information offer means.

[Claim 15] Two or more information storage devices which receive the write request of the data which high order equipment publishes, and control the writing to said data storage medium, In the control approach of the information storage system constituted from the 1st and 2nd sequence grant information offer means to offer the sequence grant information for identifying the sequence that the write-in instruction from said high order equipment was published by said information storage device In the 1st step said information storage device judges [the sequence grant information from said 1st sequence grant information offer means] whether it distributed available to be, and said 1st step When judged [that said sequence grant information cannot be used and], while said information storage device changes to the condition of not writing in the data from said high order equipment The 2nd step which notifies the purport it is directed that offers sequence grant information to said 2nd sequence grant information offer means, The control approach of an information storage system that said 2nd sequence grant information offer means becomes said information storage device from the 3rd step which notifies the purport which

resumes the writing of the data from said high order equipment when offer of sequence grant information of said 2nd sequence grant information offer means is attained.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the information storage system which has the mirroring function or copy INGU function from an information storage system (henceforth a copied material site) to the information storage system (henceforth a copy place site) which consists of two or more information storage devices, and which consists of one or more sets of information storage devices.

[0002]

[Description of the Prior Art] In order that an information storage system may give the facilities on the improvement in the response engine performance to the demand from information processors, such as a host computer, and employment of the accumulated information, to be constituted by two or more sets of information storage devices is

desired. And for the maintenance and management, the data stored in the information storage system are constituted so that it may be copied to other information storage systems.

[0003] When there is a write request from high order equipments (only henceforth high order equipment), such as a server which is a kind of an information processor, and a host computer, to the record medium of a copied material site, a write request is published at coincidence also to the information storage system which constitutes a copy place site, and both information storage systems call it synchronous system copy processing to perform copy processing, checking receipt of the write request in each information storage device.

[0004] However, the method of performing the writing of the data to a copy place site regardless of the writing of new data to a copied material site is proposed for the purpose which mitigates the latency time of the high order equipment of a copied material site, or an information storage device. Such an approach is called asynchronous system copy processing.

[0005] By the way, if it does not know whether to be the thing which was published from high order equipment, to write in and by which directions were published in what kind of sequence at the copied material when performing such asynchronous system copy processing, each information storage device of a copy place cannot judge whether I may write in in any sequence.

[0006] It is because data are not necessarily transmitted to a copy place site in order of the instruction which the processing advance condition of each information storage device of a copied material site differed, and high order equipment not necessarily published by dispersion in the engine performance of the information storage device which receives the amount of data of the input directions published from high order

equipment, and its data etc.

[0007] The function which adds for every write command as a means to get to know the sequence of such writing, by using as a time stump issue time of day when the write-in command from high order equipment was carried out, and is published to an information storage device was developed. This function was realized as an operating function of high order equipment, and it also became possible to go on write-in processing about to the thing of which time of day the writing received from high order equipment ended each information storage device connected to high order equipment by this time stump, taking a check mutually by the communication link between information storage devices.

[0008] The Sysplex timer (IBM9037) of IBM adds the above functions to the mainframe which is high order equipment.

[0009] Moreover, an information storage device internal clock gives a time stump, or it is also known that it will also be possible to perform to give time amount with directions of the writing from the above high order equipments by the information storage device side which received directions from high order equipment, and an information storage device will give a time stump using a time server, GPS (GLOBAL POSITIONING SYSTEM), a remote-control internal-organs clock, etc. Thus, in a copy place site, the sequence which should write in data can be recognized by giving a time stump and transmitting the data copied to a copy place site from a copied material site.

[0010] On the other hand, when a certain failure occurs to a copied material site, it is necessary to get to know to the thing of which timing write-in processing has terminated normally for the restoration. Then, each information storage device of a copied material asks mutually the processing to where was completed, checks advance of mutual write-in processing, and suits. Such consensual validation will be called if the

synchronization between information storage devices is taken.

[0011] The technique which carries out copy INGU of the information is known for the field of an information storage system by the system constituted with another information storage device supposing the case where a failure occurs to one part of the information storage systems, disaster, etc. as above-mentioned. In recent years, in order to give the facilities on the improvement in the response engine performance to the demand from a copied material information storage device, and employment of the accumulated information also in the storage system of a copy place site, being constituted by two or more sets of information storage devices came to be proposed.

[0012] The order of writing is controlled by the copy place site, he being conscious of the sequence which the data transmitted from the copied material site and its writing generated. Moreover, it communicates between the equipment, and each information storage control unit of a copy place also runs write-in processing, taking synchronization that wrote in and writing was made to the thing of which time of day with reference to the time stump about order obtained from the information storage device of a copied material.

[0013]

[Problem(s) to be Solved by the Invention] When there is only one timer which constitutes a means to acquire the order of data receipt from high order equipment and offer of the data receipt time of day from the means, data receipt sequence information, etc. stops, it becomes impossible by the way, to maintain the actuation which held the synchronization between two or more information storage devices also in the copy place site also in a copied material site.

[0014] Moreover, as other technical problems, as mentioned above, when a copy place site is the information storage system which consists

of two or more information storage devices, since it has engine performance sufficient also as a copied material site, the deployment is desired. The copy between the information storage systems constituted among such two or more information storage devices is called the remote copy of M pair N.

[0015] For example, it is possible it not only uses the resource as a copy place site, but that it is going to constitute it so that it may be available also as a former site of a copy. These are using a copy place site as a new copied material site, when a certain failure occurs to maintenance of a copied material site, the facilities on employment, or a copied material site, and generally they are called a site change.

[0016] However, about the remote copy of M pair N, even if it only connects bidirectionally the equipment about the change of such a site which sufficient examination is not carried out but is proposed now, a site cannot be changed. The invention in this application is made in order to solve the above troubles.

[0017]

[Means for Solving the Problem] In order to solve an above-mentioned problem, the information storage system in this application the 1st invention has the 1st sequence grant information offer means and the 2nd sequence grant information offer means generate the sequence grant information for discriminating the sequence that the write-in instruction was published to the information storage device from high order equipment, and said 1st and 2nd sequence grant information offer means carry out mutually-independent [of it], and it is constituted. That is, the 1st sequence grant information offer means and the 2nd sequence grant information offer means consist of the separate roots, respectively so that an information storage device can be provided with sequence grant information.

[0018] Moreover, in order to solve an above-mentioned problem, a definition means to define any one of the 1st and 2nd sequence grant information offer means as a master sequence grant information offer means is established, and an information storage system constitutes so that it may fix using which sequence grant information offer means the issue sequence of a write-in instruction is acquired. It made it possible to take a redundant configuration, without the 1st sequence grant information offer means and the 2nd sequence grant information offer means competing by this.

[0019] It has a judgment means to judge how it is. offer of the sequence grant information from said 1st sequence grant information offer means to said information storage device is still more possible for an above-mentioned configuration -- When the judgment result of said judgment means is what shows an offer impossibility It was constituted, and other redundancy-ized sequence grant information offer means are changed without delay, and it enabled it to use them so that said definition means may redefine said 2nd sequence grant information offer means as a master sequence grant information offer means.

[0020] On the other hand, when acquisition of the sequence grant information by the sequence grant information offer means was not completed, the information storage device which checked that sequence grant could not be carried out normally constituted so that the write request from high order equipment might not be performed, so that the dependability of the data stored in the information storage device might not be spoiled.

[0021] The information storage device which checked that sequence grant could not be carried out normally further again constituted so that the notice of a purport which is made not to perform the write request from high order equipment might be notified to other information storage

devices which constitute an information storage system. Thus, by making the purport which is made not to perform the write request from high order equipment notify by information storage device initiative, it is not influenced by the condition of an external device but consciousness ****** of all information storage devices can be performed.

[0022] It constituted from performing discharge in the condition of on the other hand saying that the write request from high order equipment is not performed, ignited by the notice from the sequence grant information offer equipment which was redefined and became a master so that employment could be resumed, where use of sequence grant information is attained completely.

[0023] On the other hand, in order to realize the remote copy method of a M pair N configuration, the means of communications which performs the communication link between the information storage devices which constitute each information storage site was prepared, and while making two-way communication possible, it constituted so that sequence information might be given to any site from a sequence grant information offer means.

[0024] Moreover, when a judgment means to judge whether sequence grant information offer is normally possible for the sequence grant information offer equipment formed in each site was established and offer impossible was detected, it constituted so that the actuation might be made to take over to the sequence grant information offer means connected to other sites.

[0025] Since it was the case where the distance between a sequence grant information offer means and the offer place equipment of the sequence grant information separates, it had the timing skew section further again.

[0026] When sequence grant information was offered for information

storage device itself using the local memory of a processor own [said] which accumulates the timer value which the self-propelled timer counted with the clock of a processor own [in an information storage device] and its self-propelled timer counted on the other hand, it constituted so that the timer value in local memory might be amended based on the sequence grant information acquired from the sequence grant information offer means.

[0027]

[Embodiment of the Invention] About the operation gestalt of this invention, a detail is explained below using a drawing. Drawing 6 is drawing showing one example of the hard configuration of the copied material site 100 in this invention, and the copy place site 200. The copied material site 100 and the copy place site 200 are bidirectionally connected through the channel 300.

[0028] Connecting through a direct cable can also connect this connection using a public line. The copied material site 100 consists of two or more information processors 101 and two or more information storage devices 110. An information processor 101 is high order equipment which publishes writing and a read-out instruction to an information storage device 110, and the information processor 101 is connected with the information storage device 110 which is low order equipment through repeating installation 180. In this Fig., although explained using the condition of having connected through repeating installation 180, connecting with a direct cable is also possible.

[0029] An information storage device 110 is constituted by the memory control unit section 112 which controls the writing and read-out to the disk unit 116 which is the record medium which writes in the data to which writing was directed from the information processor 101, and a disk unit 116.

[0030] In the memory control unit section 112, two or more control processors which control control of a disk unit 116, the information transfer between information storage devices 110, etc. and which are not illustrated are arranged. The timer equipments 130 and 140 are timer equipment which provides an information storage device 110 independently with sequence grant information, respectively.

[0031] When any one is used as master side timer equipment 130 and failure generating is carried out at master side timer equipment, the remaining standby side timer equipment is used for timer equipment as master timer equipment. Redundancy is given and master side timer equipment 130 and standby side timer equipment 140 are constituted so that it can communicate mutually in another Rhine, as shown in drawing. In this example, although direct continuation is carried out to each of an information storage device 110, master side timer equipment 130 and standby side timer equipment 140 may be constituted so that these may also be connected through repeating installation 180.

[0032] It is constituted like [the copy place site 200] the copied material site 100. Of course, the storage structure of a system of a copy place site can change the number of an information storage device 210, and the number of an information processor 201 suitably from the facilities on the employment, and a viewpoint of cost effectiveness. Moreover, the information processor 101 and the information processor 201 are mutually connected possible [a communication link] through the circuit 310. As long as this circuit is the network network of arbitration, it may be large-scale WAN using a public line etc. also in Point to Point.

[0033] On the other hand, although the gestalt to which an information processor 101 and an information storage device 110 are connected was explained in this Fig. using the repeating installation which consists of

SUITCHINNGUHABU etc., these connecting means can also be further connected [the bridge represented by the repeater represented by for example, a hub and wavelength multiplexing division equipment and the switching hub and] through a public line further through a router between remote places. On the other hand, these communications protocols are SCSI and FIBRE. According to the specification of its circuit besides CHANNEL etc., it is variously selectable and the multi-protocol communication link through the gateway can also be adopted.

[0034] In addition, in the communication link between 110 between information storage devices, the topology of the shape of a loop formation and a star configuration can be taken using the communication link repeating installation 180. Of course, it is also possible by connecting a direct cable to take the gestalt of connection of the shape of a loop formation and a star mold. It becomes possible to be made to transmit information to the adjoining information storage device 110, in taking a loop-formation-like topology, and when the information storage device 110 which started the informational transfer receives the information which self transmitted in this case, it can detect that all information was transmitted to the information storage device 110. Moreover, in this case, when communication failure etc. occurs in one circumference direction, it is changing to the reverse circumference direction communication direction, and communication link redundancy can be secured.

[0035] Drawing 1 is drawing having shown notionally the information flow in the information storage system of this invention. Drawing 2 is drawing having shown the information flow between an information processor 101 and an information storage device 110 in the detail especially among the information flows shown by drawing 1 . In drawing 1 , through an

information channel 105, two or more information storage devices 110 receive in-and-out force directions of the data from the information processor 101 which is high order equipment, and control the writing to account media of information, such as a magnetic disk constituted in the information storage device 110, and read-out from an information record medium.

[0036] An information storage device 110 consists of the memory control unit section 112 and a disk unit 116 which is an information storage, as shown in drawing 2 , and the memory control unit section 112 records temporarily the write-in data from an information processor 101 on cache memory 181, and it controls the writing of the information on a disk unit 116 by the control means 184 which consists of microprocessors etc. based on the control information accumulated in the memory 182 for control.

[0037] Moreover, information processors, such as a personal computer, realize, and to the memory control unit section 112, the assistance PC 120 shown in drawing 2 is used in order to set up the management information or to display the situation of the memory control unit section 112. As long as an information processor 101 is an information processor which processes information, it may be a personal computer aiming at personal YUZU, or may be a mainframe computer or a server. Moreover, as a disk unit 116, record media, such as a magnetic tape besides a magnetic disk and a semi-conductor, are raised. These storages 116 may take a RAID configuration.

[0038] It is connected possible that two or more information storage devices 110 receive sequence grant information from each of at least two or more sequence grant information offer means 130 and 140 through information channels 132 and 142. This sequence grant information offer means can also be constituted from a timer, as shown

in drawing 1 , and it can incorporate the information on still more nearly another counter means from the outside, and it can also constitute it so that sequence grant information may be offered, so that it may mention later.

[0039] The information from these sequence grant information offer means 130 and 140 is used in order that an information storage device 110 may acquire the time of day and sequence of having received the write request of data from one information processor of the information processors 101. these sequence grant information offer means 130 and 140 -- the time check of GPS, the timer within a sequence grant information offer means, etc. -- when an acquisition means realizes and it takes a timer configuration, with the counter which increments periodically, the counter which carries out a decrement, a counter value is generated and an information storage device 110 is provided with this counter value. An information storage device 110 can acquire the information about sequence with the input directions from the high order equipment of information- processor 101 grade by using the timer value, when input directions are received from either of the information processors 101.

[0040] As long as these sequence grant information offer means 130 and 140 are established after at least two or more have become independent, and it decides the master sequence grant information offer equipment 130 used as the master usually used out of it at the time of operation and all the information storage devices 110 can receive offer of sequence grant information normally, sequence grant information acquires from the sequence grant information offer equipment 130 used as a master.

[0041] Each between each information storage device 110 carried out the information communication link of how far other information storage

devices are processing the data write request from the information processing means 101 mutually, as shown in 115 of drawing 1 , and it checks and recognizes the mutual processing state. As an approach of taking the synchronization between such storage, each information storage system is connected in the shape of a loop formation as above- mentioned, and how to communicate at any time to the adjoining information storage device 110 can be considered.

[0042] Moreover, sequence grant information offer means 140 other than master side sequence grant information offer means 130 used as the master shown in drawing 2 are defined as a sequence grant information offer means by the side of standby. A failure occurs for the master side sequence grant information offer means 130, or cutoff etc. comes to an information channel 132. When sequence grant information stops reaching an information storage device 110, the sequence grant information offer means 140 by the side of standby is newly defined as a master, and succeeds the actuation through an information channel 142. Moreover, it is possible to constitute also so that the instruction for changing a master and standby side may be published through assistance PC 120 for maintenance of an information storage system 100, check, etc. and a standby side can succeed actuation as a new master sequence grant information offer means. Moreover, if it is in the notice of a change instruction of the master from PC120, and standby, between sequence grant information offer means can be connected directly, and it can also constitute so that this instruction can be notified to both sequence grant information offer means.

[0043] By the way, high order equipments, such as a server of the copied material site 100 and a host computer, may need to exchange [operating continuation] the role of the site of a copy place a copied material by the case where it becomes impossible, and its maintenance

service, according to generating of disaster etc. In such a site change, bidirectional information transfer needs to be constituted for each information storage device 110 of a copied material site, and the information storage device 210 of a copy place site possible through information channels 320 and 322. Connecting through a direct cable can also connect this connection through the repeating installation 180 of arbitration using a public line. It becomes possible to define an information channel as hard flow logically towards the information storage device 110 of a copied material site from the information storage device 210 of a copy place by the configuration for which these bidirectional data transmission and reception are possible, when a copied material site and a copy place site need to be changed.

[0044] As an information channel which transmits such information, TAG/BUS (parallel I/F) and ESCON I/F (serial I/F) in a mainframe are begun, and the protocol of arbitration, such as SCSI, FIBRE CHANNEL Protocol (FCP), and IP, is applied. If it is in the information channel 320,322 between sites especially, it may be LAN and a WAN environmental course with various communication link backbones, such as other T3 of IP, and ATM. However, a site change is unrealizable only by establishing a channel for bidirectional information in this way. As mentioned above, when a copied material site and a copy place site change, it is because it is necessary to form the sequence grant information offer means 230 and 240 also in a copy place site beforehand. Each sequence grant information offer equipments 230 and 240 and each information storage device 210 which are shown in drawing 1 provide an information storage device 210 with sequence grant information through an information channel 242 like a copied material site. In the change of a this copy former site and a copy place site, i.e., site change implementation, it cannot not necessarily be

overemphasized that the sequence grant information offer means 130 does not need to take a redundant configuration to each site, respectively.

[0045] That is, it becomes that it is possible in arranging one sequence grant information offer means in a copied material and each copy place, respectively, using any one as a master side sequence grant information offer hand, holding down cost, collateralizing the redundancy of the equipment of a timer with constituting other sequence information offer means so that it may become a standby side sequence grant information offer means, and corresponding also to a site change as shown in drawing 11 .

[0046] Drawing 3 illustrates one of the concrete configurations of a sequence grant information offer means. Carrying this sequence grant information offer means as a function of general-purpose hardware using software can also constitute itself as independent equipment. The sequence grant information offer means 130 shown in drawing 3 distributes the clock which the internal clock dispatch section 133 sends to an information storage device 110 through the clock distribution section 135. Having the counter which specifically counts the clock which the internal clock dispatch section sends, the clock dispatch section 135 distributes the counter value which the counter counted to an information storage device 110.

[0047] An information storage device 110 is using this timer value, and acquires the sequence which received the write-in instruction from an information processor 101. Moreover, it is also possible to constitute from an information storage device 110 side based on this timer value, so that event generating time of day, such as write-in receipt and failure generating, may be calculated, and various event generating time of day can be offered as information intelligible for a user in this case.

[0048] In drawing 3, it constitutes so that a clock value may be distributed to an information storage device 110 by the clock dispatch section 133 in sequence grant information offer equipment 130, but a means to accumulate sequence grant information in RAM in sequence grant information offer equipment can be established, and it can also constitute so that an information storage device 110 may read the value.

[0049] As other approaches, as shown in drawing 4, it can also constitute from external clock distribution equipment 410 so that a clock may be acquired. In this case, the clock acquired from the external clock is counted and that counted value is distributed to an information storage device 110 through the clock distribution section 135. Moreover, it is also possible to replace with external clock distribution equipment 410, and to incorporate the time-of-day signal of GPS400 grade.

[0050] The case where clock information is acquired from the external clock distribution equipment 410 in drawing 4 here is further explained to a detail. When using GPS400, the time information from GPS400 is received in the external clock receive section 132. The external clock receive section 132 recognizes the received time information, performs required conversion, timing (skew), etc., and acquires a required clock value or time information. On the other hand, when replacing with clock information from GPS400 and acquiring clock information by reception of external clock distribution equipment 410, by the external clock receive section 132, the clock value from an external clock distribution means is received, the recognition, conversion, time-of-day adjustment (skew), etc. are performed, and a required clock value or time information is acquired. Here, GPS400 and any one external clock distribution equipment 410 in drawing 4 can also be used alternatively, both are used for them, and they may prepare them possible [proper use] as other external clock distribution equipments 410 are used for

the time amount which cannot use GPS400.

[0051] The clock information acquired from the external clock distribution equipment 410 which received the sequence grant information offer means 130 as other examples which give sequence information, It asks for strict current time from the internal clock or internal generation clock of sequence grant information offer means 130 self. The value which applied the adjustment value (skew value) in consideration of the distance between the information storage devices measured further beforehand is computed as time of day for a synchronization between information storage devices, and you may make it distribute the time of day for a synchronization to each information storage device 110 through the clock distribution section 135.

[0052] The time information which should be given when carrying out the purpose of carrying out the remote copy of asynchronous system, while the precision of the time of day in this case holds the coordination of write-in information is not the need of being a strict clock. the shortest time when the time of day of a precision finer than the shortest time amount which directs by high order equipment writing in can be expressed at, and an information storage device can process write-in directions of 1 -- also depending -- if correspondence at the time of day of a fine precision is possible, it can use enough as time of day for a synchronization.

[0053] Moreover, the directions means 138 which consists of computers which have a control panel is connected to the sequence grant information offer means 130, and this directions means 138 performs extension, ****, etc. of each device within the sequence grant information offer means 130. Acquisition of the fault information, the actuation log, etc. of the sequence information offer means 130 can be performed now using the screen of this directions means 138. The

directions means 138 is good also as remote attachment via communication networks, such as not only being laid by equipment external but LAN. Carrying out common loading can also realize this directions means 138 constitutionally to the assistance PC 120 shown in drawing 1 of information storage device 110 attachment.

[0054] The notice for the sequence grant information offer means from the control panel of the directions means 138 from directions or an information storage device 110 is received in event reception / response section 136, and the equipment or the directions which performed processing to the directions and took out directions with event analysis / processing section 134 by event reception / response section 136 course again is answered to the equipment which should be transmitted.

[0055] The main functions which this event reception / response section 136 performs the information which shows that the sequence grant information offer equipment by the side of a master was exchanged for the sequence grant information offer means 140 by the side of standby as below-mentioned As opposed to one of information storage devices 110 to the function notified to an information storage device 110, and the information processor 101 When it is received that the notice (henceforth the notice of rejection) of a purport which refuses the write-in instruction which the information processor 101 published was made, other information storage devices 110 are received at an information processor 101. There is a function to perform the notice for directing to publish the notice of rejection similarly etc.

[0056] If it puts in another way, this event analysis / processing section 134 and event reception / response section 136 will be faced changing a master side sequence grant information offer means and a standby side sequence grant information offer means, and will publish the instruction

about the preparation which an information storage device side should perform. In copy INGU between information storage system sites, it must be recognized also in the copy place site in what kind of sequence the write-in instruction from high order equipment was carried out in the copied material site as explained previously.

[0057] Therefore, each information storage device needs to be controlled, collateralizing maintaining the condition that the reception sequence of the write-in instruction from high order equipment can give correctly. Then, when changing a master [of a sequence grant information offer means], and standby side, or when performing a site change, the sequence grant information offer means whose distribution of sequence grant information was attained is led, and control instruction to each information storage device is published.

[0058] Of course, above-mentioned control instruction can be constituted so that it may be made to any 1 information storage device, and it can also be constituted so that it may transmit between information storage devices 110 after that. Anyway, it is sufficient, if it constitutes so that offer of sequence grant information may not stop working [an information storage device], and initiation and interruption of the actuation may be performed ignited by actuation of sequence grant information offer equipment. In in the same site, transfer of such control instruction is performed through the repeating installation 180 of Fig. 6, and, in a transfer of the information on the information storage device of the copied material site 100 to the copy place site 200, it is carried out through a channel 300. In addition, other sequence grant information offer means 140, 230, and 240 are constituted similarly.

[0059] Drawing 5 is drawing having shown the example of a configuration by the side of the information storage device 110 which receives the sequence grant information offered from the sequence grant information

offer means 130. From the clock distribution section 135 of the sequence grant information offer means 130 by the side of a master, a clock signal is distributed and, specifically, the clock receive section 500 in the information storage control unit section 112 receives the signal. When the increment of the counter of the synchronous timer memory 501 in the timer information storing memory 514 is carried out and an increment is normally carried out based on the received signal, normal receipt is recorded on the status memory 502. In this example, in normal termination, the status memory 502,512,522,532 is turned off as a configuration with the flag, and when normal termination is not detected, it is considering as a configuration which is turned on.

[0060] The sequence grant information from the sequence grant information offer means 130 by the side of a master can redundancy-ize information acquisition of sequence information offer means 130 and others by the side of a master with constituting so that it may receive even in the clock receive section 520 constituted independently [the clock receive section 500]. The sequence grant information received in this clock receive section 500 and the clock receive section 520 is accumulated in the synchronous timer memory 501 and 521 of the respectively different timer information storing memory 514 and 524, respectively. Similarly, it is received by the clock receive section 510 and the clock receive section 530, and the sequence grant information from the sequence grant information offer means 140 by the side of standby is stored in the different synchronous timer memory 511 and 531, respectively. As shown in drawing 4 , sequence grant information acquired from the sequence grant information offer means 130 by the side of a master and sequence grant information acquired from the sequence grant information offer means 140 by the side of standby are constructed and ** (ed), it divides into two memory groups, and

redundancy is guaranteed by considering as another configuration in hard.

[0061] A still more suitable example is explained using drawing 14 . Since drawing 14 corresponds to a high-speed I/O demand from high order equipment, it is the configuration which added processors 600 and 610 to the configuration of drawing 5 . Thereby, the self-propelled timer generated with the clock of this processor 600 and 610 self can be used as sequence grant information. In drawing 14 , this processor 600 is formed in the interior of the memory control unit section 112.

[0062] Next, actuation of a processor 600 is explained. The self-propelled timer counted with the clock of a processor 600 is accumulated in the timer memory 610 in the local memory of processor 600 self, and an information storage device 110 gives sequence information to the **** for timer values, and a write-in instruction from an information processor 101. In this case, in order to maintain the precision of that timer, according to the precision of a self-propelled timer, the synchronous timer memory 501 in the timer information storing memory 524 is accessed periodically at necessary minimum, and a timer value is amended.

[0063] Since the exact synchronous timer from the outside which carries out point ** is accumulated in the synchronous timer memory 501, with reference to this value, the timer value in the timer memory 610 is amended. This can constitute the timer which can perform sequence grant also to a high-speed I/O demand.

[0064] If it puts in another way, when it will constitute so that a timer value may be accumulated in the local memory of a microprocessor proper and an information storage device will use the timer value, I hear that a microprocessor 600 is enabled to make access to other microprocessors and the memory of the microprocessor exterior to

share into the minimum, and it becomes possible [aiming at improvement in control speed], and there is. In addition, you may make it offer the access timing to a sequence grant information offer means using a status flag further, as shown in 611 of drawing 14 . ON of the specific bit of especially a counter and OFF can be read, and it can also use as a flag.

[0065] Next, the procedure which changes the sequence grant information offer means 130 by the side of the master which are the main configurations of this invention, and the sequence grant information offer means 140 by the side of standby is explained using a flow chart. Drawing 7 is a flow chart which shows the procedure of data write- in processing of an information storage device 110 when there is a write- in instruction from an information processor 101.

[0066] An information storage device 110 starts write- in processing, when the write- in instruction from an information processor 101 is received, and when there is no write- in instruction, it does not process. (Steps 701 and 706) When the write request from an information processor 101 is made to an information storage device 110, an information storage device 110 judges the status flag of the synchronous timer 502 shown in drawing 5 generated in response to offer from the sequence grant information offer means 130 which has become the present master side of the inside in an information storage device 110. (Steps 701- 702) This status flag is a flag which shows whether the sequence grant information from the sequence grant information offer means 130 was normally acquired as above- mentioned, and if the flag is off, sequence grant information will acquire sequence grant information as what is obtained normally with reference to the sequence grant information on the synchronous timer memory 501 shown in drawing 5 . (Step 703) About the on- off control of this status

flag 502, it mentions later in drawing 9 and drawing 10 .

[0067] The control means 184 of the memory control unit section 112 shown by drawing 2 gives the information for identifying sequence to the data while writing the data which received the write-in instruction from the inside of an information processor 101 in cache memory 180. Since the data which carried out information grant for identifying sequence are transmitted when performing the copy to a copy place site, the sequence which should write data in a storage can be recognized also in a copy place site. A control means 184 controls the writing to the disk unit 116 of the data in cache memory 180. (Steps 704-705) .

[0068] Here, according to a certain failure, an information storage device 110 cannot receive normally sequence grant information from the sequence grant information offer equipment by the side of a master, but, generally the condition that the status flag is turned on, and the case where the change factor of the master of a sequence grant information offer means is detected are explained. In step 702, when ON of the change factor status flag of a master is detected, an information storage device 110 performs processing which sends back the data directed in writing to an information processor 101. It changes to the condition of not receiving the writing of the data from an information processor 101 with it. That is, the notice of rejection is published to an information processor. It is for not receiving the information which cannot give exact sequence information. (Such a condition is written in below and it is called a data inflow refusal condition.) (steps 707-708)

In the exchange on SCSI I/F which connects an information storage device with an information processor, as long as the hard resource allows the write request from an information processor, carrying out the queuing of the information storage device side will be continued. Then, when requiring the change of such a master side timer and a standby

side timer, and an information storage device 110 does not issue the notice of the purport which is ready for receiving data transfer in the information processor 101, it becomes possible to refuse the write request of data.

[0069] Moreover, to other information storage devices 110 which constitute the information storage system 100, the information storage device 110 (henceforth a rejection issue former information storage device) which detected status flag = ON and maintained the write-in data inflow refusal condition is written in to an information processor 101, and carries out "a notice which demands to change in the data inflow refusal condition" ("notice of a master change condition"), respectively. (Step 709)

the rejection issue former information storage device 110 -- "a notice which demands to change in the data inflow refusal condition" -- other all -- a check of what the information storage device 110 received publishes the notice of "the purport changed to a master" to the sequence information grant means by the side of standby. (Steps 711-712)

Here, although the case where the rejection issue former information storage device 110 constituted so that a reply signal may be altogether checked from an information storage device 110 was illustrated and explained, an information storage device 110 is connected in the shape of a loop formation, and the method of performing a sequential notice is also in the adjoining information storage device 110. In this case, when the information which self published is received, it will be judged as that to which all the information storage devices 110 received issue. In this case, information can be notified to the information storage device 110 of adjoining both directions, and someday, it can also constitute so that it may be judged as or and the thing to which all the information storage

devices 110 received issue when the information which self published early was received.

[0070] As it connects in the shape of a star and a sequential notice is transmitted to the information storage device 110 of arbitration, when information storage device 110 self which detected ON of a status flag receives the information which self published, it can also constitute so that it may be judged as that to which all the information storage devices 110 received issue.

[0071] Next, actuation of the sequence grant information offer means 140 by the side of the standby in the case of drawing 7 is explained using the flow chart of drawing 8 . First, it judges whether the notice of a change to a master was received in the event receive section by the side of standby. (Step 801) When the notice of a change to a master is received, a change to a master is performed. The notice which received in event analysis / processing section shown in drawing 3 and drawing 4 is analyzed, and, specifically, the information on the purport that he became the master side is registered into event analysis processing circles. It rewrites to the information which shows that it is a sequence grant information offer means by the side of a master of the information which still more specifically shows that it is a sequence grant information offer means by the side of standby with the definition means 137 formed in the event analysis processing section.

[0072] In this case, what is necessary is just to let initial value of the sequence grant information (time check timer) given to the sequence grant information offer means which serves as a master newly be the value which considered the maximum time amount required for the change of a master and standby at the timer value by the side of the original master. Giving beforehand the timer value which can fully give next sequence to the sequence information grant means by the side of

standby rather than a master side as initial value as other approaches can also desire continuation of employment. Moreover, the newest value which became effective as write-in sequence grant information that it went into each information storage device 110 is listed, and a means to notify the information (timer value) newer than those newest values as sequence to the sequence grant information offer means by the side of standby can also be adopted. (Step 802)

After the change processing to a master is completed, the sequence grant information offer equipment 140 which newly became a master publishes "directions of the purport of which a rejection condition is canceled" (notice of the completion of a master change) to an information processor 101 to each information storage device 110 which constitutes a system. (Step 803)

Processing of the information storage device 110 at the time of receiving "the directions (notice of the completion of a master change) of a purport which carries out rejection discharge" from the sequence grant information offer equipment 140 by the side of a new master is explained using drawing 9 .

[0073] If the notice of the purport which the change of a master and standby completed at step 902 is received, an information storage device 110 will cancel the write-in data inflow refusal condition rejection condition to an information processor 101, and will resume reception of a write-in data demand. In this case, since the initial value which can give sequence information new enough is set up as explained in explanation of step 802 of drawing 8 , the sequence information which the sequence information grant means which newly became the master side gives becomes manageable [a storage system] continuously. (Step 903)

Here, although having explained using the notice ("a notice of a master

change condition") which requires the purport which changes in the write-in data inflow refusal condition, and the approach of giving the sequential notice of the receipt check etc. from the information storage device which became the rejecting agency, these notices can also take a means carry out with a broadcasting method via the sequence grant information offer means 140 by the side of the standby to which each information storage device 110 and the communication link root were secured.

[0074] Here, receipt of the clock signal for a synchronization of an information storage device 110 is explained using drawing 10. This status flag judges whether the sequence grant information offer means 130 or the event an information storage device 110 cannot guarantee sequence grant information to be occurred, and records that result on predetermined memory. When the sequence grant information from the sequence grant information offer means 130 is normally received by the information storage device 110 and is able to generate a counter value, a status flag 502 is maintained while it has been off. (Steps 1000, 1001, and 1004)

On the other hand, when a clock signal is not received normally, a status flag 502 is turned on. (Step 1002) In the procedure shown in drawing 10, when an information storage device side was not able to receive sequence grant information normally, it explained only the condition of turning on this status flag 502, but also when it becomes impossible to guarantee the accuracy of the sequence grant information which the clock distribution section itself has distributed now, constituting so that a status flag may be turned on is desirable.

[0075] Other examples of this application are explained here. Drawing 11 shows the block diagram of the information storage system which can perform the remote copy from the copied material site 100 to the copy

place site 200 like drawing 6 . In such an information storage system, when a certain failure occurs in the information processor which is high order equipment of a copied material site, to change a copy place site and a copied material site, and to be used is desired. In this case, at least one sequence grant information offer means is needed for each site. The site which became the copied material is because it is necessary to notify the sequence information on the write request published from high order equipment to the copy place site at the copied material. Drawing 11 shows the condition that the timer equipments 130 and 140 were connected to each one site of every.

[0076] Moreover, although standby side timer equipment took the redundant configuration and was connected with master side timer equipment in each site, the timer equipment of 1 forms in each site, respectively, the timer equipment of a copied material site defines as a master side sequence grant information offer means 130, and copy place site side timer equipment defines as a standby side sequence grant information offer means 230 in drawing 11 in drawing 6 .

[0077] The procedure of performing the site change which makes the copy place site 200 of the information storage system shown in drawing 11 using the flow chart of drawing 12 a new copied material site is explained. When the need of performing such a site change arises, the case where a certain failure occurs, and the case where it requires using the copy place site 200 as a new copied material site from a viewpoint of maintenance control are raised [******] to either the information processor 101 which constitutes a copied material site, a sequence grant information offer means or information storage device 110 grade.

[0078] High order equipment 101 supervises periodically whether the event which serves as an opportunity of a site change first has occurred. Isn't there specifically any site change demand from assistance PC 120?

a ******** [that (step 1201) and a clock required for sequence grant are received normally] (step 1202) -- or -- or there is no failure in the equipment of either of the systems (step 1203) -- etc. -- a sequential monitor is carried out. Processing is ended when neither of the conditions is recognized.

[0079] When this monitor detects a certain failure and change directions from assistance PC 120, the Failover directions from all the information processors 101 are needed. All the information processors 101 work consciousness ****** for performing Failover through a public line 310. Specifically based on the sequence information on data, it reports how far as for the information storage device 110, the write-in instruction from an information processor 101 is processed to the information processor 101 which it checks mutually and is high order equipment. Specifically, the sequence which write-in processing has ended normally checks or how far. (Step 1205)

When still more nearly required, it notifies that sending-back processing of data in which the write-in data with which the sequence after the data which the writing checked in step 1205 terminated normally is given are sent back to an information processor 101 is performed to an information storage device 110. (Steps 1206 and 1207)

Furthermore, the notice of the purport which stops the writing of the data used as the sequence after the data which writing ended normally in the copied material site to the information storage device 210 of a copy place site similarly is transmitted. (Step 1208)

In the site change by having detected the failure, it is step 1208 if needed. Before directions of the site change from high order equipment are published, detection of the equipment which the failure generated, degeneration of the equipment, and a lock out activity are done. On the other hand, the information storage device 210 of the copy place site

200 When the site change instruction of step 1208 of above drawing 12 is received, the purport which serves as a master to the timer equipment 230 which is a sequence grant information offer means in an own site immediately is notified. This condition is explained using the flow chart of drawing 13 .

[0080] The information storage device of a copy place site will direct the purport which serves as a master side sequence grant information offer means to the sequence grant information offer means 230 of an own site, if directions of a site change are received (steps 1301 and 1302). It can carry out as the configuration by which writing is not started except performing the writing to write-in data which is carrying out write-in termination normally at a copied material, when still more nearly required after the site change instruction from high order equipment was published by this (1303 1304) which maintains the information which does not accept the write request from the information processor 201 which is high order equipment until preparation of the timer equipment which gives sequence information is completed.

[0081] Timer equipment 230 is the procedure shown by drawing 8, and the same procedure, and is deeds about the change processing to a master. Timer equipment 230 will notify the purport which change processing completed to other storage 210 which constitutes the same information storage system 200, if a change to a master is completed.

[0082] Furthermore, like the write-in re-start process shown in drawing 9, each information storage device 210 starts the copy of asynchronous system which transmits the information which gave write-in sequence information to the new copy place site 100 as a new copied material site 200 while receiving the write-in data from an information processor 201.

[0083] Thus, a period when the condition that a site change should be performed occurs, until preparation of a sequence grant information

offer means is completed, The condition of refusing acceptance of data is maintained. New copy origin and a copy place In response to the directions of which data acceptance refusal is canceled from the sequence grant information offer means which newly became a master, by resuming actuation, where sequence information is added certainly, a data transfer can be performed now to a new copy place site.

[0084] Here, although explained focusing on the information storage device 110 and the sequence grant information offer means, it faces still more specifically performing a site change, and the Failover directions from all the information processors 101 are needed. It is because the original and copy of the remote copy pair from an information processor 101 interchange in a site change, so deletion of a remote copy pair is once needed. Therefore, it cannot be overemphasized that procedures, such as information interchange about of which time writing is normally completed between an information processor 101 and an information storage device 110 and between an information processor 201 and an information storage device 210, are needed in order to maintain the identity of data.

[0085]

[Effect of the Invention] An information storage system strong against a failure can be offered by making into a redundant configuration the sequence grant information offer means for giving the order of receipt of write-in information used when a copied material site or a copy place site performs a remote copy in the information storage system which consists of one or more information storage devices, as stated above.

[0086] On the other hand, when each site of a copy place consisted of two or more storage systems such copy origin, since the sequence grant information offer means was established also in the copy place site, the site change which changes a copied material site and a copy place site

was enabled. By this, the resource of the site of a copy place can also be effectively utilized now. Furthermore, while inhibiting the initial investment of an information storage system by taking a redundant configuration with the sequence grant information offer means of a copied material site and a copy place site, the storage system distribution which has the high remote copy function of availability is made. As employment especially to a site change, a copied material site like this application and a copy place site by the specification of the remote copy which has two or more information storage devices In the invention in this application which made the timer part the redundant configuration to all pairs being suspended only by a timer failure occurring in each site when the timer redundant configuration was not taken, the effectiveness that the stability of a system becomes very high can be acquired.

[0087] Moreover, since a remote copy is resumed ignited by the completion of a change of the timer equipment which newly becomes a master side in the case of a site change, and distributes sequence grant information at it, it becomes possible to provide certainly with sequence grant information the information storage system which newly becomes a copied material.

[0088] Moreover, the sequence grant information offer means which can respond to a high-speed I/O demand from high order equipment can be constituted by the technique the information from a sequence grant information offer means amends the sequence grant information acquired by the self-propelled timer by the internal processor of an information storage device.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing having shown the information flow in this invention.

[Drawing 2] It is drawing having shown the information flow between the information storage device of this invention, and high order equipment.

[Drawing 3] It is drawing having shown the example of a configuration of the sequence grant information offer means of this invention.

[Drawing 4] It is drawing having shown other examples of a configuration of the sequence grant information offer means in this invention.

[Drawing 5] It is drawing having shown the example of a configuration by the side of the information storage device which receives the information from the sequence grant information offer means in this invention.

[Drawing 6] It is drawing having shown the example of the storage structure of a system in this invention.

[Drawing 7] It is the flow chart having shown write-in processing of the data in this invention.

[Drawing 8] It is the flow chart having shown change processing with the master side sequence grant information offer means in this invention, and a standby side sequence grant information offer means.

[Drawing 9] It is the flow chart having shown the write-in re-start process in this invention.

[Drawing 10] It is the flow chart having shown the clock receipt processing in this invention.

[Drawing 11] It is drawing having shown the example of the storage structure of a system in this invention.

[Drawing 12] It is the flow chart having shown one example of the site change processing in this invention.

[Drawing 13] It is the flow chart having shown one example of the site

change processing in this invention.

[Drawing 14] It is drawing having shown the configuration of the sequence grant information offer means in this invention.

[Description of Notations]

100 -- A copied material site information storage system, 101 -- Information processor, 110 -- An information storage device, 200 -- Copy place site information storage system, 201 -- An information processor, 210 -- An information storage device, 130 -- Master side sequence grant information offer means, 140 -- A standby side sequence grant information offer means, 112 -- Memory control unit section, 182 [-- Information channel,] -- The memory for control, 184 -- A control means, 120 -- Assistance PC, 310 180 [-- External clock distribution equipment,] -- Repeating installation, 280 -- Repeating installation, 300 -- A channel, 410 500 [-- Timer information storing memory, 524 / -- Timer information storing memory, 600 / -- A processor, 610 / -- Local memory] -- A clock receive section, 501 -- Synchronous timer memory, 502 -- A status flag, 514